19.3A: Natural Selection and Adaptive Evolution

Natural selection drives adaptive evolution by selecting for and increasing the occurrence of beneficial traits in a population.

Learning Objectives

- Explain how natural selection leads to adaptive evolution

Key Points

- Natural selection increases or decreases biological traits within a population, thereby selecting for individuals with greater evolutionary fitness.
- An individual with a high evolutionary fitness will provide more beneficial contributions to the gene pool of the next generation.
- Relative fitness, which compares an organism’s fitness to the others in the population, allows researchers to establish how a population may evolve by determining which individuals are contributing additional offspring to the next generation.
- Stabilizing selection, directional selection, diversifying selection, frequency-dependent selection, and sexual selection all contribute to the way natural selection can affect variation within a population.

Key Terms

- **natural selection**: a process in which individual organisms or phenotypes that possess favorable traits are more likely to survive and reproduce
• **fecundity**: number, rate, or capacity of offspring production

• **Darwinian fitness**: the average contribution to the gene pool of the next generation that is made by an average individual of the specified genotype or phenotype

## An Introduction to Adaptive Evolution

Natural selection only acts on the population’s heritable traits: selecting for beneficial alleles and, thus, increasing their frequency in the population, while selecting against deleterious alleles and, thereby, decreasing their frequency. This process is known as adaptive evolution. Natural selection does not act on individual alleles, however, but on entire organisms. An individual may carry a very beneficial genotype with a resulting phenotype that, for example, increases the ability to reproduce (fecundity), but if that same individual also carries an allele that results in a fatal childhood disease, that fecundity phenotype will not be passed on to the next generation because the individual will not live to reach reproductive age. Natural selection acts at the level of the individual; it selects for individuals with greater contributions to the gene pool of the next generation, known as an organism’s evolutionary fitness (or Darwinian fitness).

![Figure](image.png)

**Figure**: Adaptive evolution in finches: Through natural selection, a population of finches evolved into three separate species by adapting to several different selection pressures. Each of the three modern finches has a beak adapted to its life history and diet.

Fitness is often quantifiable and is measured by scientists in the field. However, it is not the absolute fitness of an individual that counts, but rather how it compares to the other organisms in the population. This concept, called relative fitness, allows researchers to determine which individuals are contributing additional offspring to the next generation and, thus, how the population might evolve.

There are several ways selection can affect population variation:

- stabilizing selection
- directional selection
- diversifying selection
- frequency-dependent selection
- sexual selection

As natural selection influences the allele frequencies in a population, individuals can either become more or less
genetically similar and the phenotypes displayed can become more similar or more disparate. In the end, natural selection cannot produce perfect organisms from scratch, it can only generate populations that are better adapted to survive and successfully reproduce in their environments through the aforementioned selections.

Galápagos with David Attenborough: Two hundred years after Charles Darwin set foot on the shores of the Galápagos Islands, David Attenborough travels to this wild and mysterious archipelago. Amongst the flora and fauna of these enchanted volcanic islands, Darwin formulated his groundbreaking theories on evolution. Journey with Attenborough to explore how life on the islands has continued to evolve in biological isolation, and how the ever-changing volcanic landscape has given birth to species and sub-species that exist nowhere else in the world.